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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/782,215	02/13/2001	W. Royall Cox	62305.79287	9704

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EXAMINER	
MARKHAM, WESLEY D	
ART UNIT	PAPER NUMBER
1762	

DATE MAILED: 06/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/782,215	COX ET AL.	
	Examiner	Art Unit	
	Wesley D Markham	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-20 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 13 February 2001 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☒ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Response to Amendment

1. Acknowledgement is made of applicant's preliminary amendment A, filed as paper #3 on 10/1/2001, in which the specification of the instant application was amended to note that the invention was made with government support. Claims 1 – 20 are currently pending in U.S. Application Serial No. 09/782,215, and an Office Action on the merits follows.

Information Disclosure Statement

2. Acknowledgement is made of the IDS filed by the applicant as paper #2 on 7/13/2001. The references listed thereon have been considered by the examiner as indicated on the attached copy of the PTO-1449 form.

Oath/Declaration

3. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02. The oath or declaration is defective because joint inventor Chi Guan signed but did not date the declaration.

Drawings

4. This application lacks formal drawings. The informal drawings filed in this application (i.e., 7 sheets, 12 figures, filed on 2/13/2001) are acceptable for examination

purposes. When the application is allowed, applicant will be required to submit new formal drawings.

5. The drawings are objected to because the photograph of the microlens in Figure 11 is unclear (i.e., dark and fuzzy). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

6. The use of the trademarks SK9, NOA-73, OG146, and FC-324 has been noted in this application (see pages 13 – 14 of the specification). The trademarks should be capitalized wherever they appear and be accompanied by the generic terminology. Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.
7. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: Claim 9 requires that at least one of the first and second optical polymeric fluids be a UV curable pre-polymer, and that the method further include the step of exposing at least one of the first or second optical polymeric fluids to UV radiation during the depositing step to help control the aspect ratio/shape of the formed microlens. This process step/limitation is not found or discussed in the specification, and therefore the specification is objected to as failing

to provide proper antecedent basis for the claimed subject matter (i.e., the subject matter of Claim 9).

Claim Observations

8. The examiner makes the following observations regarding the claims of the instant application:

- Claim 8, line 1: The word "wherein" appears to be misspelled "where in". In other words, the claim appears to contain a typographical error.
- Claim 12, line 3: The phrase, "depositing a second optical polymeric having an index of refraction about..." appears to contain a typographical error. It appears to the examiner that the phrase should read, "depositing a second optical polymeric fluid having an index of refraction about..."
- The transitional phrases (1) "further including" in Claim 9 and (2) "includes" in Claim 16 have been reasonably interpreted by the examiner to be equivalent to "further comprising" and "comprises", respectively (i.e., to be "open" language).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 1 – 13 and 15 – 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Canon KK (JP 11-142611 A), referred to hereinafter as Canon, in view of Hayes et al. (USPN 5,707,684).

12. Regarding independent Claim 1 (from which Claims 2 – 10 depend), Canon teaches a method of fabricating gradient index microlenses in optical polymeric fluids using an ink-jet printhead (Abstract, Figures 1 and 2, and paragraphs [0009], [0012], [0016], and [0017]), the method comprising depositing a layer (i.e., layer "2" in Figure 1 and layer "23" in Figure 2) of a first optical polymeric fluid having an index of refraction onto a substrate (Figures 1 and 2, and paragraphs [0012], [0013], [0016], and [0017]), depositing a second series of droplets (i.e., droplets "22" in Figure 2) of a second optical polymeric fluid compatible with the first optical polymeric fluid from an ink-jet printhead (i.e., printhead "21" in Figure 2) onto the layer formed with the first optical polymeric fluid, the second optical polymeric fluid

having an index of refraction higher than that of the first optical polymeric fluid (Abstract, Figures 1 and 2, and paragraphs [0009], [0012], [0013], [0017], [0019], [0020], and Examples 1 and 2), holding the formed microlens under conditions which permit inter-diffusion of the layer formed from the first optical polymeric fluid (lower refractive index) and the droplets of the second optical polymeric fluid (higher refractive index) to create a generally uniform gradient index of refraction in the microlens (Abstract and paragraphs [0009], [0012]. [0013], and [0020]), and "stiffening" (i.e., solidifying) the formed microlens after a time period in order to retain a desired degree and uniformity of gradient in the index of refraction of the microlens (paragraphs [0020], [0021], [0024], and [0027]). Canon does not explicitly teach (1) depositing a first series of droplets of the first optical polymeric fluid from an ink-jet printhead, (2) coalescing the first series of droplets to form the base portion of a partially formed microlens, and (3) coalescing the second series of droplets to create a fully formed microlens having a base portion of the first optical polymeric fluid under a cap portion of the second optical polymeric fluid. In other words, Canon teaches depositing a layer of the first optical polymeric fluid to form a base portion of the microlens as opposed to a coalesced series of droplets of the first optical polymeric fluid from an ink-jet printhead to form the base portion of the microlens, as claimed by the applicant. However, it is clearly the intent of Canon to form a series of gradient index microlenses on a substrate by first depositing a low refractive index polymeric material, then depositing a second, higher refractive index polymeric material on top of the low refractive index polymeric material, and

then inter-diffusing the materials to form the gradient index microlenses. Hayes et al. teaches a method of forming microlenses by ink-jet printing a series of droplets of an optical polymeric material onto a substrate and coalescing the series of droplets (Abstract, Figure 11, Col.2, lines 8 – 49, Col.3, lines 63 – 67, Col.4, lines 1 – 11, Col.7, lines 54 – 59, Col.8, lines 1 – 7 and 23 – 35, Col.10, lines 28 – 32, and Col.12, lines 38 – 45). Importantly, Hayes et al. also teaches that this ink-jet printing process can be repeated at a single substrate site in order to create a compound microlens (i.e., by first printing an optical polymeric fluid having a refractive index to form the base of a microlens and then printing a second, compatible optical polymeric fluid having a different refractive index on top of the base to form the compound microlens) (Figure 21 and Col.15, lines 39 – 59). The ink-jet printing process of Hayes et al. has many benefits, such as (1) the ability to precisely deposit a wide range of materials in a wide variety of shapes, and (2) a high degree of flexibility (i.e., the ability to vary process parameters such as the number and location of deposited microdroplets, printhead temperature and orifice size, target substrate temperature, and surface wettability in order to fabricate arrays of microlenses with dimensions ranging from 80 microns to 1 mm and to precision levels of just a few microns (Col.2, lines 8 – 49). It would have been obvious to one of ordinary skill in the art to deposit both the first, lower refractive index optical polymeric material and the second, higher refractive index optical polymeric material of Canon by using the ink-jet printing / droplet coalescing process of Hayes et al. with the reasonable expectation of (1) success, as Hayes et al. teaches that such a

process was known in the art at the time of the applicant's invention, and the optical polymeric materials of Canon can clearly be deposited by an ink-jet printing process (e.g., as evidenced by the fact that Canon teaches using an ink-jet printing process to deposit the second series of droplets of the optical polymeric fluid), and (2) obtaining the benefits of using the ink-jet printing process of Hayes et al. to deposit both the low and high refractive index optical polymeric materials of Canon (i.e., instead of only the high refractive index material), such as the ability to precisely deposit a wide range of materials in a wide variety of shapes, and the ability to vary process parameters such as the number and location of deposited microdroplets, printhead temperature and orifice size, target substrate temperature, and surface wettability in order to fabricate arrays of microlenses to precision levels of just a few microns. One of ordinary skill in the art would have done so (i.e., utilized the ink-jet printing process to deposit both materials of Canon) on the occasion that a discrete array of individual, gradient index microlenses is desired as opposed to a continuous layer containing an array of gradient index microlenses. The combination of Canon and Hayes et al. does not explicitly teach that (1) the microlenses have a generally uniform axially gradient index of refraction, and (2) the formed microlens has a reduced focal spot as compared to a non-gradient index microlens of the same character. However, the gradient obtained by the applicant's claimed process and the properties associated with that gradient (i.e., the reduced focal spot) appear to be solely a function of the process used to form the microlenses. As the combination of Canon and Hayes et al. reasonably suggests

performing all of the applicant's claimed process steps and limitations, the microlenses produced by the process suggested by the combination of Canon and Hayes et al. would have inherently possessed the physical properties claimed by the applicant (i.e., the generally uniform axially gradient index of refraction and reduced focal spot) unless essential process steps and/or limitations are missing from the applicant's claims.

13. The combination of Canon and Hayes et al. also teaches all the limitations of Claims 2 – 13 and 15 – 20 as set forth above in paragraph 12 and below, including a method wherein / further comprising:

- Claim 2: The second optical polymeric fluid has an index of refraction about 0.01 or greater than the index of refraction of the first optical polymeric fluid (paragraph [0017] and Examples 1 and 2 of Canon).
- Claim 3: The depositing and coalescing steps are performed relatively simultaneously wherein previous drops are coalescing while additional drops are being deposited (Figures 11 and 21, and Col.10, lines 28 – 34, Col.12, lines 40 – 45, and Col.14, lines 52 – 60 of Hayes et al.).
- Claims 4 and 5: The steps of depositing the first optical polymeric fluid (Claim 4) and the second optical polymeric fluid (Claim 5) are performed with a printhead heated to an elevated temperature sufficient to reduce the viscosity of the first and second optical polymeric fluids to less than about 40 centipoise (Figures 3 and 21, and Col.5, lines 10 – 22, Col.8, lines 23 – 35, and Col.9, lines 32 – 58 of Hayes et al.).

- Claim 6: The first and second optical polymeric fluids are selected from the group consisting of pre-polymers and polymers (paragraphs [0016] and [0017] of Canon, and Col.8, lines 23 – 35, and Col.15, lines 45 – 49 of Hayes et al.).
- Claim 7: At least one of the optical polymeric fluids is selected from the group of polymers / compounds recited by the applicant in Claim 7. Specifically, Canon teaches depositing polyacrylics, polycarbonates, and polystyrenics as the first and second optical polymeric fluids (paragraphs [0016] and [0017]), and Hayes et al. teaches depositing polymers such as polyimides and epoxies as the optical polymeric fluids (Col.8, lines 23 – 35), all of which are compounds recited by the applicant in Claim 7.
- Claim 8: At least the first or second optical polymeric fluid is heat or UV curable, and the solidifying step is accomplished by applying heat or UV radiation to the formed microlens after the holding step (paragraphs [0015], [0021], and Examples 1 and 2 of Canon; Figure 10, and Col.4, lines 1 – 11, Col.8, lines 51 – 67, and Col.9, lines 1 – 9 of Hayes et al.).
- Claim 9: At least one of the first and second optical polymeric fluids is a UV curable pre-polymer, and the method further comprises the step of exposing at least one of the first and second optical polymeric fluids to UV radiation during the depositing step to help control the aspect ratio/shape of the microlens (Col.4, lines 1 – 11, Col.8, lines 63 – 64, and Col.9, lines 10 – 20 of Hayes et al.).

- Claim 10: The substrate has a surface treated to be non-wetting with respect to the first optical polymeric fluid to help control the aspect ratio of the formed microlens (Col.7, lines 30 – 59, Col.11, lines 29 – 33, and Col.12, lines 40 – 45 of Hayes et al.).
- Claim 11: Independent Claim 11 (from which Claims 12 – 20 depend) is drawn to a method of fabricating an array of gradient-index microlenses. As such, in addition to the process steps and limitations discussed above in reference to Claim 1, Claim 11 requires performing the ink-jet printing of the first and second optical polymeric fluids at a plurality of sites on a substrate to form an array of gradient-index microlenses. This is done by providing an ink-jet printhead adapted to deposit a series of droplets of the first optical polymeric fluid from a first orifice and a second series of droplets of the second optical polymeric fluid from a second orifice. The combination of Canon and Hayes et al. teaches these limitations (Abstract, Figures 1 and 2, and paragraphs [0011] and [0028] of Canon; Figure 21 (which shows the ink-jet print head with two orifices as claimed by the applicant) and Col.15, lines 39 – 59 of Hayes et al.).
- Claim 12: The second optical polymeric fluid has an index of refraction about 0.01 or greater than the index of refraction of the first optical polymeric fluid (paragraph [0017] and Examples 1 and 2 of Canon).
- Claim 13: The substrate is moved relative to the printhead in order to move the orifices from site to site (Figures 3 and 21, and Col.5, lines 24 – 34, Col.12, lines 10 – 31, and Col.15, lines 41 – 49 of Hayes et al.).

- Claims 15 and 16: The steps of depositing the first optical polymeric fluid (Claim 15) and the second optical polymeric fluid (Claim 16) are performed by heating the fluids to an elevated temperature sufficient to reduce the viscosity of the first and second optical polymeric fluids to less than about 40 centipoise (Figures 3 and 21, and Col.5, lines 10 – 22, Col.8, lines 23 – 35, and Col.9, lines 32 – 58 of Hayes et al.).
- Claim 17: The first and second optical polymeric fluids are selected from the group consisting of pre-polymers and polymers (paragraphs [0016] and [0017] of Canon, and Col.8, lines 23 – 35, and Col.15, lines 45 – 49 of Hayes et al.).
- Claim 18: At least one of the optical polymeric fluids is selected from the group of polymers / compounds recited by the applicant in Claim 18. Specifically, Canon teaches depositing polyacrylics, polycarbonates, and polystyrenics as the first and second optical polymeric fluids (paragraphs [0016] and [0017]), and Hayes et al. teaches depositing polymers such as polyimides and epoxies as the optical polymeric fluids (Col.8, lines 23 – 35), all of which are compounds recited by the applicant in Claim 18.
- Claim 19: The first or second optical polymeric fluid is heat or UV curable, and the solidifying step is accomplished by applying heat or UV radiation to the formed microlens (paragraphs [0015], [0021], and Examples 1 and 2 of Canon; Figure 10, and Col.4, lines 1 – 11, Col.8, lines 51 – 67, and Col.9, lines 1 – 9 of Hayes et al.).

- Claim 20: The substrate has a surface treated to be non-wetting with respect to the first optical polymeric fluid to help control the aspect ratio of the base portion of the partially formed microlens (Col.7, lines 30 – 59, Col.11, lines 29 – 33, Col.12, lines 40 – 45, and Col.15, lines 39 – 59 of Hayes et al.)

14. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Canon KK (JP 11-142611 A), referred to hereinafter as Canon, in view of Hayes et al. (USPN 5,707,684), and in further view of Weitzel et al. (USPN 6,027,672).

15. The combination of Canon and Hayes et al. teaches all the limitations of Claim 14 as set forth above in paragraphs 12 and 13, except for a method wherein the printhead is moved relative to the substrate in order to move the orifices from site to site. Specifically, Hayes et al. teaches that the substrate is moved relative to the printhead in order to move the orifices from site to site (Figures 3 and 21, and Col.5, lines 24 – 34, Col.12, lines 10 – 31, and Col.15, lines 41 – 49), not vice-versa. Weitzel et al. teaches the functional equivalence of (1) moving a substrate relative to a printhead (as taught by Hayes et al.) and (2) moving a printhead relative to a substrate during the deposition of axially graded refractive index optical polymeric materials (Abstract, Col.2, lines 57 – 67, and Col.3, lines 1 – 5). Therefore, it would have been obvious to one of ordinary skill in the art to move the printhead relative to the substrate instead of moving the substrate relative to the printhead in order to move the orifices from site to site in the process of the combination of Canon and Hayes et al. with the reasonable expectation of success and obtaining similar

results (i.e., successfully ink-jet printing an array of microlenses as desired by Canon et al. and Hayes et al., regardless of whether the substrate is moved relative to the printhead, or the printhead is moved relative to the substrate).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Both Tsukada (JP 2000-108216 A) and Canon KK(2) (JP 11-142608 A) teach processes of ink-jet printing optical polymeric materials onto a substrate in order to form an array of microlenses.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (703) 308-7557. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Wesley D Markham
Examiner
Art Unit 1762

WDM
May 31, 2003

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